

Bimaxillary Total Arch Intrusion in Lingual Orthodontics for Hyperdivergent Class II Face with Asymmetry and Lip Protrusion

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Hyperdivergent Class II face is accompanied by a convex profile, while it is usually characterized by upright upper and/or lower incisors. Thus, it is important to precisely maintain an axis of upper incisors during retraction. Particularly, axis control of upper incisors is more difficult in lingual orthodontics. Unlike in the buccal appliance, traction force pushes the wire out of horizontal slot in the lingual appliance, so sufficient moment for torque control of incisors may not be obtained. Therefore, excessive overtorque should be placed on the archwire for making same amount of moment and accomplishing incisor translation. Furthermore, to correct lip protrusion and lip incompetency in this patient, bimaxillary total arch intrusion and maximum retraction of incisors was also treatment objective to improve soft tissue problems. This case report demonstrates satisfactory results through bimaxillary total arch intrusion with translation of upper incisors and intrusion of lower incisors using palatal/lingual miniscrews and continuous arch with additional torque for axis control of incisors in lingual orthodontics.

Key words: Gummy smile, Lip incompetency, Total arch intrusion, Anterior torque control

INTRODUCTION

Hyperdivergent skeletal Class II malocclusion is often accompanied by convex profile with retrognathic chin and lip protrusion. Additional dental characteristics may be relatively upright upper and/or lower incisors.^{1,2} The combination of the convex profile and upright incisors makes it hard to attempt premolar extraction for the purpose of improvement of profile. Moreover, precise vertical control is essential because increase in the vertical dimension would worsen the convex profile, especially in the presence of lip incompetency. Hence a concrete vertical control, as well as controlled movement of incisors are crucial for hyperdivergent profiles when it comes to improvement of the facial profile. Regardless of the

position of the bracket attachment, i.e. labial or lingual, the bottom line must be same.

Especially, Class II division 2 (div2) with upright upper incisors and deep overbite with Curve of Spee in mandibular arch has been considered challenging due to the difficulty of incisor axis control and correction of the Curve of Spee. In this case, retraction of the anterior segment via translation or lingual root movement and intrusion of incisors for correction of Curve of Spee without change of lateral facial profile should be recognized as a main treatment goal.

In terms of anchorage preparation, orthodontic miniscrews have been widely in use, securing the reliable movement of not only single tooth, segment of teeth but also entire arch.³ The concept of 'total arch movement' can be useful for the replacement of the

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orthognathic surgery by enabling the profile changes without surgery. Namely, clockwise rotation of the mandible following bimaxillary total arch intrusion can improve retrognathic chin profile and correct lip incompetency.

In this report, we demonstrate a successful torque control of upper incisors by a combined use of mini-screws and archwire with overtorque and bimaxillary total arch intrusion for the correction of lip incompetency by counterclockwise rotation of the man-

dible in hyperdivergent skeletal Class II malocclusion with lip incompetency in lingual orthodontics.

DIAGNOSIS

A 25-year-old male patient visited the Department of Orthodontics with chief complaints of lip protrusion, gummy smile, and facial asymmetry. Clinical examination revealed convex lateral profile with lip protrusion and 4 mm lip incompetency at rest, along



Fig. 1. Pretreatment photographs.

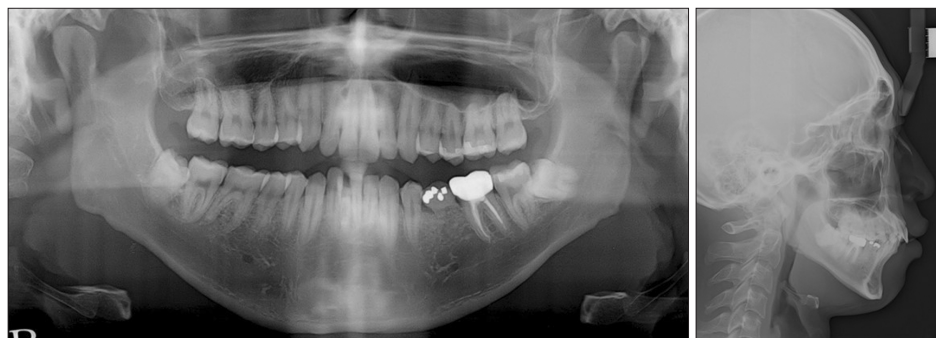


Fig. 2. Pretreatment radiographs.

with chin deviation to the right side. Excessive gingival display and maxillary occlusal plane canting was also noted at smiling.

According to the Intraoral and radiographic examination, lower left 2nd premolar was missing, and deciduous 2nd molar was retained. The overjet and overbite were both 5 mm. The molar relationship was moderate Class II molar on both sides. Deep Curve of Spee was present in the mandibular arch. The upper and lower dental midline was shift to the right side relative to the facial midline by 1.5 mm and 3 mm, respectively, which was associated with underlying facial asymmetry (Fig. 1).

The cephalometric analysis indicated a skeletal Class II jaw relationship (SNA 77.7°, SNB 70.6°, ANB +7.1°, and +5.8 mm of Wits appraisal), with upright upper incisors (U1 to SN 93.6°) and hyperdivergent facial profile (SN-GoMe, 48.0°) (Fig. 2).

In the soft tissue analysis, upper and lower lip was protrusive compared to the true vertical line. In the PA cephalogram, the menton point deviated to the right side by 2.5 mm relative to skeletal midline.

Based on the analysis, the patient was diagnosed as skeletal Class II malocclusion with missing mandibular left 2nd premolar, lip protrusion and facial asymmetry.

TREATMENT PLAN

Treatment objectives were (1) to create esthetic lip profile and smile, (2) to make the dental midlines coincident, and (3) to establish a proper posterior occlusal relationship.

Considering the underlying facial asymmetry and related occlusal plane canting, treatment options for this patient included surgical intervention to improve facial profile. Moreover, the vertical facial proportions needed to be improved to correct the gummy smile and retrusive chin profile. However, he did not take his asymmetry and profile issues seriously and surgery option was declined. Significant changes in the overall facial profile had yet to be pursued.

In summary, to improve the gummy smile, supe-

rior relocation of entire maxillary dental arch was necessary, which would effectively substitute Le Fort I maxillary jaw surgery for superior repositioning. This was supposed to cause subsequent autorotation of the mandible, which then would lead to improvement of the retrusive chin profile. Additionally, for the retraction of lips extraction of premolars and retraction of incisor segments was indispensable. Herein precision control of incisors was crucial since the incisal axes were upright in the initial cephalometric analysis. Moreover, the deep Curve of Spee needed to be flattened for the completion of the occlusion.

Taken together, considering the amount of retraction and missing state of lower left 2nd premolar, extraction plan was inevitable. Consequently, treatment options included extraction of upper 1st premolars, lower right 2nd premolar, and lower left deciduous 2nd molar. and total arch intrusion of both arches to gain esthetic lip and chin profile and to eliminate lip incompetency.

TREATMENT PROGRESS

Following the extraction of the premolars and deciduous molar, self-ligating lingual brackets (Clippy-L, Tomy Inc, Japan) were bonded on the lower teeth for alignment. In order to correct the Curve of Spee of mandibular arch, miniscrews were placed on the mandibular buccal bone between the canine and 1st premolar, and clear buttons were bonded on lower lateral incisors for segmental intrusion of lower 6 incisors.⁴ Following the alignment of mandibular teeth, 0.016 round stainless steel (SS) wire with reverse Curve of Spee was used with elastic chain for segmental intrusion of lower 6 incisors at the same time (Fig. 3).

Bimaxillary total arch intrusion along with the retraction of the incisors was then performed with miniscrews inserted on lingual interraderic bone between the 2nd premolar and 1st molar in respective dental arch. On the 0.016×0.022 SS wire with additional lingual-root-torque of 25 degrees for four incisors, intrusive translation on both incisors were



Fig. 3. Treatment progress showing segmental intrusion of lower 6 incisors.



Fig. 4. Treatment progress showing bimaxillary total arch intrusion.

performed using an oblique elastic chains engaged on the miniscrew head (Fig. 4). Constant expression of the moment from the archwire was supposed to maintain incisal axes through the retraction period. Extraction space was closed after 24 months and the treatment was finished with proper lip profile, coincident dental midline, and Class I molar relationship. Total treatment time was 35 months. Fixed retainers were placed on upper and lower anterior teeth after removing brackets.

Lateral cephalogram taken at the beginning, mid-stage and end-stage of anterior retraction were compared to confirm the treatment changes.

TREATMENT RESULT

Extraoral photographs showed esthetic smile arc

and the correction of gummy smile was confirmed. In the lateral view, proper lip and chin profile was shown, which was associated with the retraction of lip and counterclockwise rotation of the mandible after bimaxillary total arch intrusion. The ideal overjet, overbite and coincident dental midline were obtained, and Class I molar relationship was established (Fig. 5).

The final panoramic radiograph showed proper root alignment. Maxillary and mandibular incisors had mild apical root resorption, possibly due to the significant intrusive retraction. No remarkable alveolar bone resorption was noted compared to the initial record (Fig. 6).

The cephalometric superimposition registered on the sella-nasion line showed counterclockwise rotation of the mandible resulted from bimaxillary total

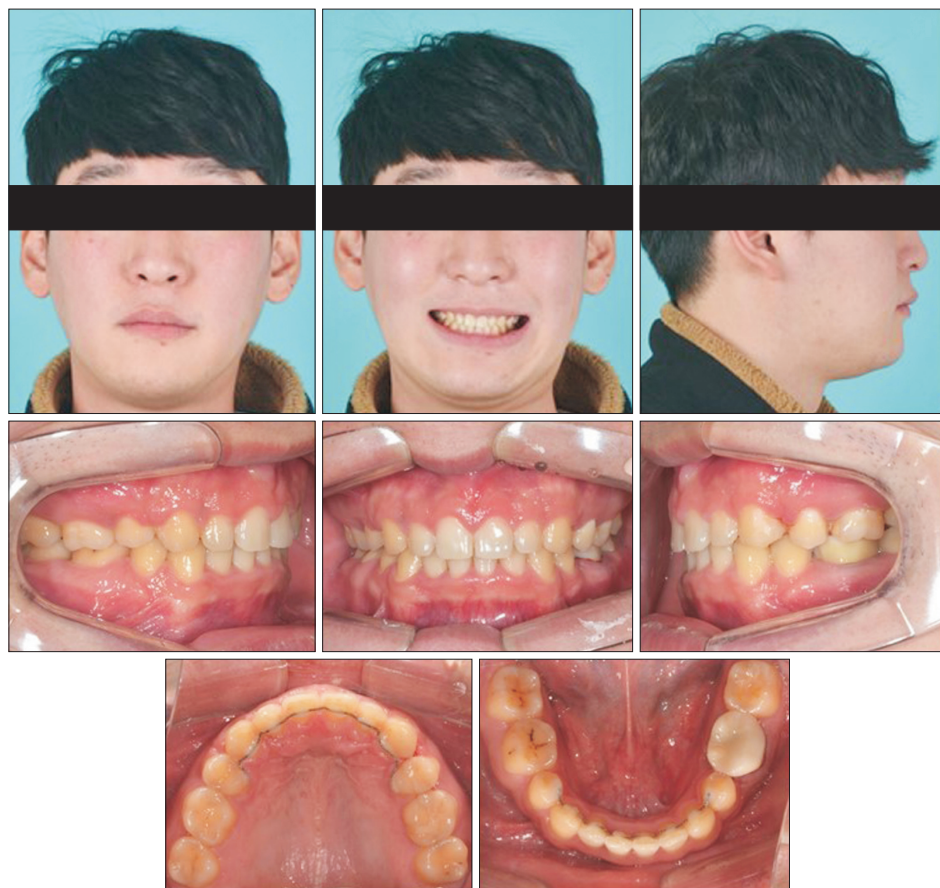


Fig. 5. Posttreatment photographs.

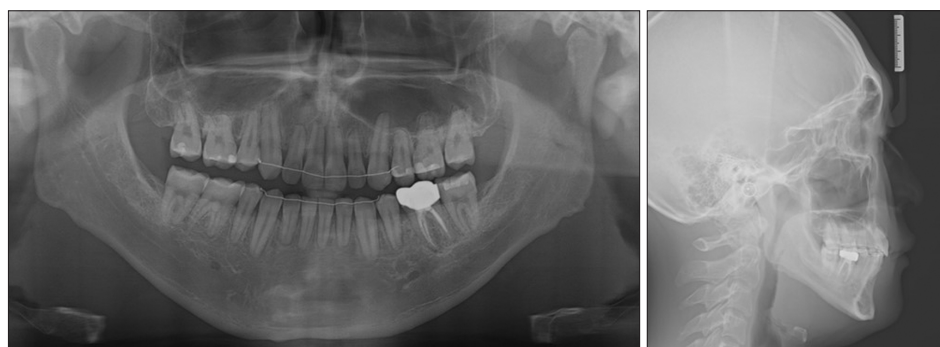


Fig. 6. Posttreatment radiographs.

arch intrusion. Related to this, improved ANB angle from $+7.1^\circ$ to $+5.2^\circ$ and improved Holdaway ratio were found. Based on true vertical line on soft tissues analysis, the protrusion of the lip was improved (Fig. 7).

According to the superimposition, upper and lower incisors showed intrusive retraction that was close to translation. Upper and lower 1st molars were also intruded, implicating bimaxillary total arch intrusion (Fig. 8).

DISCUSSION

Treatment of hyperdivergent Class II malocclusion with retroclination of the upper incisors and deep overbite would demand adequate intrusion and torque control of incisors. According to previous research, the resting pressure from the lower lip is associated with the upright upper incisors and the posttreatment relapse of its orthodontic correction.¹ Therefore, intrusion of upper incisors would

relieve the incisors away from the lower lip pressure and it would be crucial for long-term stability.^{5,6} To maintain the intruded incisors, the interincisal angle should be maintained and lower incisor tips should be in contact with the lingual surface of upper incisors.⁷ Furthermore, an appropriate inclination of incisors is crucial for proper anterior guidance. Therefore, precise vertical control (intrusion) and torque control during retraction of upright upper incisors were challenging part in the present case.

A traditional shape-driven approach using arch wire with additional to make moment for lingual root movement of upper incisors may cause flaring and extrusion of incisors⁸ according to the so-called “row-boat effect”. Hence a minimal retraction force would be indispensable. In terms of vertical control of incisors, conventional intrusive appliances such as a three-piece intrusion arch or utility arch may not be applicable to lingual orthodontic cases. Both aspects demand a 3rd party anchorage device, such as bone-borne miniscrews.

Therefore, conventional appliances appear to have limitation to gain desired type of tooth movement in the present case exhibiting retroclined and extruded incisor, which is a common characteristic of Class II div2 malocclusion. Incorporation of miniscrew-type temporary anchorage devices placed in the inter-radicular area may help eliminate the side effects of conventional appliances, since they produce a constant intrusive force vector.

However, in lingual orthodontic treatment, axis

control of incisors is more challenging than that in the labial orthodontics because of the possibility of lingual (palatal) tipping movement.⁹ In an attempt to control an axis of incisors, lever arms have been proposed and widely in use.^{10,11} However, vertical control of incisors using those lever arms remain unsolved, especially for this hyperdivergent Class II cases.¹² Translation of the upper incisors can be achieved by equivalent force system which means applying force and moment together at the archwire level.⁸ Retraction force using miniscrews and insertion of excessive anterior torque wire enable bodily movement of incisors. Unlike in the buccal appliance, traction force pushes the wire out of the horizontal slot in the lingual appliance, which would interfere with the interaction between the archwire and the bracket slot and sufficient moment for torque control of incisors may not be obtained. Therefore, in the present patient excessive archwire torque of 25 degrees was given on the archwire, to compensate for the possible wire-slot play, which resulted in adequate control of incisor inclination after treatment (Fig. 9).

This Class II patient was also accompanied by lip protrusion, lip incompetency and gummy smile. Therefore, bimaxillary total arch intrusion and maximum retraction of incisors were important treatment objectives. Since the patient had lip incompetency with convex profile, extrusive mechanics such as Class II elastics were not indicated due to the possible backward and downward rotation of the mandible.¹³

Furthermore, the patient had severe gummy smile

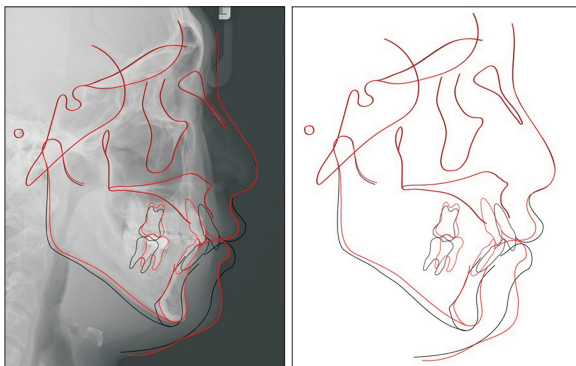


Fig. 7. Cephalometric superimposition (Black: Pretreatment; Red: Posttreatment).

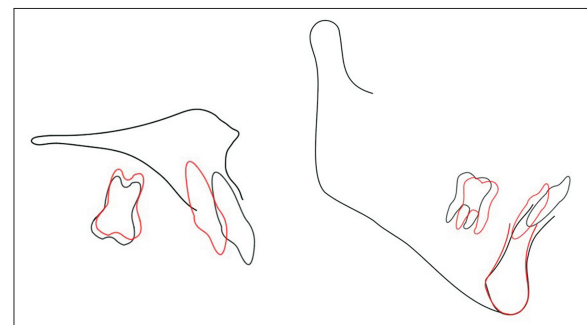


Fig. 8. Maxillary and mandibular superimposition (Black: Pretreatment; Red: Posttreatment).

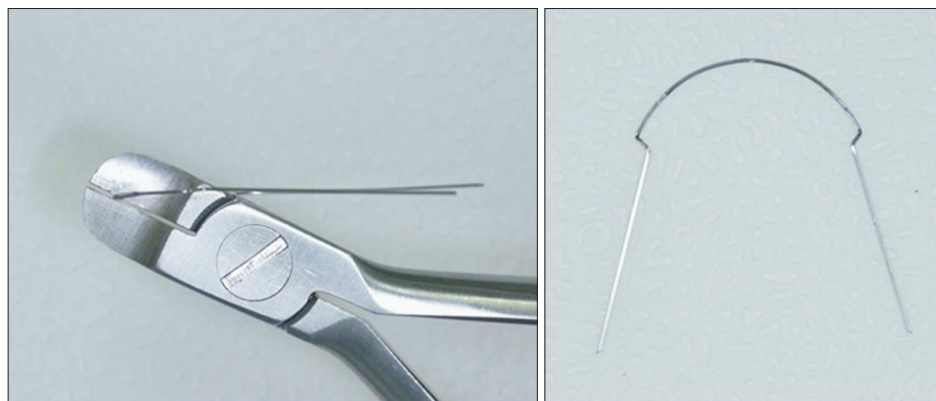


Fig. 9. Flat 0.016x0.022 SS wire with excessive overtorque of 25 degrees for translation of 4 incisors.

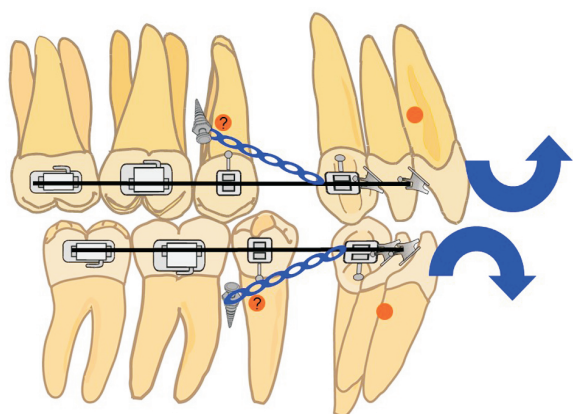


Fig. 10. Bimaxillary total arch intrusion using lingual appliance combined with palatal/lingual miniscrews.

and deep Curve of Spee in lower dentition. In order to correct the anterior deep overbite and the Curve of Spee, intrusion of both upper and lower incisors had to precede the bimaxillary total arch intrusion. Namely, the upper molars as well as the upper and lower incisors had to be intruded for the improvement of profile and completion of Class I denture relation.

In the present patient, before intrusive maximum retraction of incisors, miniscrews were placed on mandibular buccal side between the canine and 1st premolar on both sides and clear button was bonded on both lower lateral incisors for segmental intrusion of lower 6 incisors to correct deep overbite and the Curve of Spee in lower dentition. Confirming the relief of the Curve of Spee, bimaxillary total arch intrusion with maximum retraction of incisors was attained mainly by using a continuous rectangular

arch wire with partial overtorque along the incisor segment, combined with miniscrews placed maxillary and mandibular lingual bone between the 2nd premolar and the 1st molar on both sides (Fig. 10).

It is reported that the center of resistance of the maxillary dentition was approximately located at the midroot of the 2nd premolar.¹⁴ In this patient, the center of resistance of the maxillary arch may slightly shift to the posterior area due to premolar extraction. The movement of the whole dentition can be explained by the relation of the center of resistance of the whole dentition and the line of action made by the line connecting the miniscrews and archwire hooks. It is because the anterior and posterior segment were connected by the continuous arch wire. Resultantly, the posterosuperior oblique force passing through the center of resistance of the maxillary dentition, made it possible for the intrusion of both upper molars and upper incisors. As a result, counterclockwise rotation of the mandible following bimaxillary total arch intrusion can improve retrognathic chin profile and correct lip incompetency and gummy smile.

CONCLUSION

The combined use of lingual interradicular miniscrews and continuous archwire with anterior overtorque in lingual orthodontics could offer a reliable treatment strategy for hyperdivergent Class II patient. Bimaxillary total arch intrusion resulted in effective autorotation of the mandible leading to improvement

of convex profile. Additional torque control and retraction led to retraction, intrusion of incisors which contributed to improved lip profile and elimination of the gummy smile. This case implicated the possibility of the total arch intrusion even in the presence of deep bite and deep Curve of Spee, by enabling the total arch intrusion in lingual orthodontics.

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